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# Understanding the evolution of the entrepreneurial university. The case of English Higher Education institutions

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## Abstract

There has been strong policy interest in universities becoming more entrepreneurial and engaging in knowledge exchange activities as part of an expanding third mission agenda. However, our understanding of the evolution and diversity of such activities is limited. Using longitudinal data from the Higher Education Business Community Interaction (HEBCI) Survey, this study examines the evolving configuration of universities' knowledge exchange activities and stakeholders by analysing distinctive clusters of English universities. We find an increasingly diverse profile of third mission activities across different types of universities: within old, more established universities, Russell Group universities increasingly focus on research-oriented activities typically in partnership with large firms and non-commercial organisations; while another group engages in a broad range of knowledge exchange activities with low specialisation over time. Newer, less research intensive, universities increasingly rely on activities such as consultancy and formation of spin-offs. A decreased engagement with small and medium enterprises and a lower share of knowledge exchange activities at the regional level are observed across the time studied for all universities.

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## Resumen

Como parte de la expansión de la agenda de la tercera misión de las universidades, existe un creciente interés en fomentar que estas instituciones sean más emprendedoras y participen en actividades de intercambio de conocimiento. Sin embargo, comprender cuál ha sido su evolución y su diversidad tiene todavía ciertas limitaciones. Usando datos longitudinales de la Encuesta de Universidades inglesas (Higher Education and Business and Community Interaction [HEBCI]), este estudio examina cómo han evolucionado las actividades de intercambio de conocimiento entre diferentes grupos de universidades y actores no académicos (empresas, sector público). Encontramos un perfil cada vez más diverso de las actividades de la tercera misión en diferentes tipos de universidades: dentro de las universidades antiguas y más establecidas, las universidades del llamado 'Russell Group' se centran cada vez más en actividades orientadas a la investigación, generalmente en asociación con grandes empresas y organizaciones no comerciales; mientras que el resto participa en una amplia gama de actividades de intercambio de conocimiento con poca especialización a lo largo del tiempo. Las universidades más nuevas y menos intensivas en investigación, se centran cada vez más de actividades tales como la consultoría y la creación de spin-offs. A lo largo del tiempo se observa, para todas las universidades, una disminución del compromiso con las pequeñas y medianas empresas (PYMEs) y una menor participación en las actividades de intercambio de conocimientos a nivel regional.

## 1 | INTRODUCTION

In the knowledge-based economy, universities are perceived as fulfilling an ever-growing spectrum of roles: to educate and train students; to conduct and disseminate excellent research; to boost productivity through collaborative relations with external partners; to contribute to the socio-economic well-being of their localities; and to enhance civic value in the public realm. The role of universities in broader economic and community development is not new, but has been given greater impulse by recent policies and initiatives designed to encourage interactions among universities, government and industry. Governments in most Organisation for Economic Co-operation and Development countries are actively supporting the third mission of universities in addition to teaching and research (Molas-Gallart, Salter, Pastel, Scott, & Duran, 2002; Rasmussen, Moen, & Gulbrandsen, 2006), and encouraging universities to engage in knowledge exchange (KE) activities with societal and economic/industrial partners (Guerrero & Urbano, 2012; Huyghe & Knockaert, 2014; Kenney & Goe, 2004; Philpott, Dooley, O'Reilly, & Lupton, 2011).

Studies of the entrepreneurial university (Clark, 1998) and the triple helix university–industry–government interactions (Etzkowitz & Leydesdorff, 2000) have highlighted the role of universities as engines of regional as well as national development, while concepts such as third mission and KE have put the focus on the nature and diversity of interactions between universities and external partners. A growing number of studies has identified drivers and determinants of universities' engagement and entrepreneurial activities (Abreu, Demirel, Grinevich, & Karatas-Ozkan, 2016; Hughes & Kitson, 2012; Klofsten et al., 2019). However, they tend to focus on the macro-level of institutional and governance configurations (Geuna & Muscio, 2009), somehow obscuring the dynamics underpinning these relationships and interactions at the micro level (Tuunainen, 2005). In this expected transition towards the entrepreneurial university, the diverse and dynamic ways in which individual universities are pursuing this agenda is therefore overlooked. This runs the risk of presenting the entrepreneurial university as a 'global phenomenon with an isomorphic developmental path' (Etzkowitz & Leydesdorff, 2000, p. 313).

While increasing global competition acts as a homogenising force on universities to be entrepreneurial (Mohrman, Ma, & Baker, 2008; Pinheiro & Stensaker, 2014), we argue that there is 'no typical way to become an "entrepreneurial university"' (Lawton Smith & Bagchi-Sen, 2010, p. 806). In the light of this, the paper addresses the following research question: In what ways have universities responded to the pressure to be more entrepreneurial? More specifically, we ask, how have the third mission profiles of universities changed and evolved over time in terms of KE activities and partnerships involved?

This paper seeks to contribute to the debate of whether universities are increasingly driven towards institutional isomorphism (DiMaggio & Powell, 1983) to follow the entrepreneurial university model, or finding their own heterogeneous pathways to be entrepreneurial. We provide empirical evidence on the evolution of the entrepreneurial university by examining how different universities select and shift their third mission activities over time. We do this by looking at the KE efforts that universities undertake over the years, including a regional and multi-actor dimension, that underpin these interactions. These dimensions are analysed empirically using data from the Higher Education Business Community Interaction (HEBCI) Survey for English universities and covering the period between 2003/4 and 2011/12. England is an interesting case to study given the successive waves of policy pressure on universities towards the inclusion of KE and entrepreneurial activities as part of their main missions. Our analysis investigates how the third mission has been re-configured and evolving over time across different types of universities.

The paper is structured as follows. Section 2 situates the entrepreneurial university literature against our conceptual framework and presents the propositions behind our investigation. It unpacks third mission activities by delineating the three dimensions to be employed in the empirical section as well as presents it under the study context. Section 3 focuses on the diverse institutional context of English Higher Education, presenting the empirical approach of the paper: the data sources used and methodology adopted. Section 4 presents and discusses the results while Section 5 reflects on the main implications of this study and links our findings to a broader set of literature.

## 2 | LITERATURE REVIEW

### 2.1 | Isomorphic pressures versus heterogeneous evolution paths: Towards an entrepreneurial university

The entrepreneurial university literature has developed over the years with different disciplinary approaches (e.g., Clark, 1998; Guerrero, Cunningham, & Urbano, 2015). The model has been portrayed as a step in the natural evolution of the university system (e.g., Rothaermel, Agung, & Jiang, 2007; Uslu, Calikoglu, Seggie, & Seggie, 2019; c.f. Martin, 2012). According to Etzkowitz (1998), universities have undergone two academic revolutions: a first revolution characterised by the institutionalisation of the research university, followed by a second academic revolution incorporating economic development as part of their mission<sup>1</sup> (Etzkowitz, 1998). In this context, universities are seen to be placing a higher priority on being relevant and responsive to broader stakeholder needs, and these efforts have resulted in a progressive institutionalisation of third mission activities alongside

teaching and research (see Charles, Kitagawa, & Uyarra, 2014), including the objective of 'improving regional or national economic performance as well as the university's financial advantage and that of its faculty' (Etzkowitz & Leydesdorff, 2000, p. 313). The more recent concept of the engaged university (Goddard, 2009) goes even further and advocates that the third mission of economic development should be a guiding and integral principle of the organisation and practice of universities and not just a separate strand of activities.

DiMaggio and Powell (1983) developed the idea of institutional isomorphism. This perspective helps us understand the recent transformation of universities towards becoming more entrepreneurial, driven by pressures to access additional funding sources, and by government third mission policies and incentives encouraging collaboration between universities and external partners (Abreu & Grinevich, 2013; Guerrero et al., 2015; Kitagawa, Sánchez-Barrioluengo, & Uyarra, 2016; Laredo, 2007). Greater competition for funding as well as government incentives for the entrepreneurial turn could therefore be seen as top-down coercive, normative and mimetic isomorphic forces (DiMaggio & Powell, 1983) acting upon universities. This leads to our first proposition: universities have been pushed towards the entrepreneurial university model to meet external macro environmental demands by adopting similar practices and internal changes despite their institutional diversity and organisational differences.

The implicit portrayal of the entrepreneurial university model as an inevitable, homogeneous and isomorphic development path (Etzkowitz & Leydesdorff, 2000) has recently been put into question (Philpott et al., 2011; Tuunainen, 2005). Scholars have highlighted the tensions and contradictions that are likely to emerge between different university missions and activities and argued that the degree and form of this entrepreneurial transformation is likely to vary across countries and types of universities (see, e.g., Huyghe & Knockaert, 2014; Jacob, Lundqvist, & Hellsmark, 2003; Martinelli, Meyer, & Tunzelmann, 2008). In a study of Spanish universities, Sánchez-Barrioluengo (2014) identified strong differences in the performance and capabilities of universities to balance teaching with the new third mission. In the case of United Kingdom (UK), Degl'Innocenti et al. (2019) found a positive and non-linear effect between efficiency in generating income from industry engagement and research performance. However they found that for old universities this effect did not go beyond a certain threshold, whereas new universities appear to be in a better position to improve research by incentivising industry engagement. Case studies have also shown the lack of a unified approach regarding the appropriateness of the third mission, as well as clear tensions and differences across the sector on the meaning and type of entrepreneurial engagement (Benneworth & Jongbloed, 2010; Marginson & Considine, 2000; Philpott et al., 2011). Arguably, universities with different organisational heritage play different roles, reflecting institutional priorities, cultures and governance structures, as well as specialisation and research intensity (Abreu et al., 2016; Abreu & Grinevich, 2013; Hewitt-Dundas, 2012; Perkmann, King, & Pavelin, 2011).

Paradoxically, government policies to promote third mission activities<sup>2</sup> have been applied rather uniformly with little account for these differences (see, e.g., Hewitt-Dundas, 2012). This naturally generates a number of tensions, not least the ability and capacity of universities to balance a broad range of new tasks seemingly added on to their traditional core missions of teaching and research. As De la Torre, Rossi, and Sagarra (2018, p. 11) argue, 'not all HEIs are equally equipped and prepared to interact with industry, and initiatives designed to get HEIs to work with business [...] might not work with all of them'. It could therefore be argued that not all universities would respond to external pressures and incentives in the same way or interact with stakeholders in a similar fashion. Using indicators of research, teaching and engagement activities, De la Torre et al. (2018) found that institutional profiles influence the types of activities universities engage in and the stakeholders they respond to. In turn, activities influence resources and stakeholders have preferences for different activities, in a mutually interdependent and recursive way. Universities also respond to pressures and perceived challenges in their environments by adapting and developing their own third mission strategies. Based on documentary analysis of third mission strategies, Kitagawa et al. (2016) for instance showed how English HEIs strategically and deliberately target different areas of activities, partners and geographical areas based on their perceived strength. As suggested by Martin (2012), different types of universities' functions evolve differently over time as they respond to changing social, political and economic environments. Jacob et al. (2003) similarly argue that the transition towards an entrepreneurial university is an evolutionary process that takes several years because both infrastructural and

cultural changes are necessary. By combining different set of missions, capabilities and resources universities build relationships and legitimacy over time, which would ultimately lead to third mission configurations that are highly differentiated rather than isomorphic.

In the light of this, we can argue that any analysis of the evolution of the entrepreneurial university needs to start from an acknowledgement of the heterogeneous nature of HEIs. Diverse pathways can co-exist within the 'entrepreneurial university', and hence no one-size-fits-all entrepreneurial model exists (Benneworth, Pinheiro, & Sánchez-Barrioluengo, 2016; Philpott et al., 2011; Sánchez-Barrioluengo, 2014). This leads to our second proposition: the choice of KE activities reflects individual heterogeneous evolution paths in terms of their positioning within the specific Higher Education sector. However, there is still limited understanding of the ways in which universities reorient their third mission over time (Charles et al., 2014; Hewitt-Dundas, 2012; Kitagawa et al., 2016; Klofsten et al., 2019). Evidence tends to be limited to particular types of universities (e.g., research intensive), narrow sets of activities (e.g., around commercialisation), or involve cross-sectional rather than temporal analysis of third mission engagement. In the next sections we aim to provide a broader analysis of the evolution and reconfiguration of KE activities of HEIs.

## 2.2 | Unpacking third mission activities and the stakeholders involved in KE

The types of third mission activities within individual institutional contexts are wide ranging (Guerrero & Urbano, 2012; Huyghe & Knockaert, 2014; Kenney & Goe, 2004; Philpott et al., 2011; Rothaermel et al., 2007). These interactions have been variously referred to as entrepreneurial activities, academic entrepreneurship, knowledge transfer, academic engagement and KE activities. In the remainder of this paper we use the term knowledge exchange (KE) as it better captures the broad-encompassing and diverse nature of the third mission activities (Hayter, Rasmussen, & Rooksby, 2018; Perkmann & Walsh, 2007), reducing the linear conceptualisation of the highly used technology transfer denomination (Bradley, Hyter, & Link, 2013) and highlighting a bi-directional exchange of knowledge between academic and non-academic actors (Roper & Hirth, 2005). Unlike the narrower term of academic entrepreneurship, it acknowledges interactions that go beyond commercial benefit, including engagement with the public sector and non-governmental organisations. Scholars have demonstrated that KE mainly occurs through softer or open channels such as publications and consultancy activities (Cohen, Nelson, & Walsh, 2002; Perkmann & Walsh, 2007), student placements and generally the production of graduates as human capital development (Faggian & McCann, 2009; Iammarino & Marinelli, 2011) rather than 'hard' commercial activities such as patenting, licensing and spin-off activities (Philpott et al., 2011).

Despite this breadth of activities, there is a tendency to give privilege to the commercialisation of research results and the protection of intellectual property (IP) emanating from universities (such as patents and licences), neglecting other types of KE activities which can be less visible (or less easily quantifiable), but equally or even more important (Breznitz & Feldman, 2012; D'Este & Patel, 2007; Hughes & Kitson, 2012). Concerns have also been raised about the appropriateness of expecting all universities to effectively undertake the same narrow set of commercialisation activities (Hewitt-Dundas, 2012; Rosli & Rossi, 2016), particularly considering that most of the income from patenting is heavily skewed towards a few patents in specific sectors in a small number of universities (Mowery & Nelson, 2004), and that a too heavy focus on IP may even hinder collaboration by imposing additional transaction costs on firms (Nelson, 2001).

University-society interactions often entail the use of several activities simultaneously (Levy, Roux, & Wolff, 2009) and there is an increased tendency for universities and businesses to forge longer-term, strategic alliances encompassing a range of links closely tailored to the needs of the companies, rather than single, ad-hoc links (Geiger & Sá, 2008). Activities such as training, internships and consultancy tend to go hand in hand and generally enable the development of capacities to initiate other harder or more formal KE activities (Laredo, 2007).

Therefore the first dimension that we seek to explore is concerned with the breadth, or mix, of KE activities that universities are involved in. In the UK, Hewitt-Dundas (2012) found strong variation in the degrees and types of knowledge transfer activities across the sector. While highly research-intensive universities tend to focus on

the exploitation of IP and maximising returns from research (see also Guerrero et al., 2015), low research-intensive ones tend to focus mainly on activities related to human capital development. Hussler, Picard, and Tang (2010) compared the approaches to academic valorisation activities in three different regions in Italy, Germany and China. They observed strong differences in terms of the key actors, with a strong focus on small and medium enterprises (SMEs) in Milan vis à vis medium and large firms in Chongqing in China, and the types of instruments used to support KE, with greater use of direct mechanisms for the adoption/exploitation of academic research like spin-offs, mobility of human capital or training programmes in Chongqing compared to the European regions. Another study in China (Eun, Lee, & Wu, 2006) found that the nature of academic entrepreneurship was affected by the low absorptive capacity of industrial firms and the underdeveloped intermediary institutions.

The second dimension of KE activities recognises the diversity of partners involved in these interactions, including with industrial partners but also with the public and third (not for profit) sectors (Hughes & Kitson, 2012), and their different inclinations and incentives to engage with (regional) universities. Different types of stakeholders may have different preferences in terms of activities and types of universities. For instance, large companies tend to be more attracted to work with a university because of its research reputation, while small firms tend to demand more routine services and consultancy, which are more likely to be sourced from their local universities (see also Pinto, Fernández-Esquinas, & Uyarra, 2015; Siegel, Wright, & Lockett, 2007).

Although universities are increasingly encouraged to facilitate KE within their regions, the extent to which universities engage with regional partners has been found to be contingent on the mode of interaction, the type of university (e.g., age and research intensity) and the characteristics of the region, including the presence of innovation support structures and structural characteristics of firms (D'Este & Iammarino, 2010; Hewitt-Dundas, 2012; Lawton Smith & Bagchi-Sen, 2010). Newer universities tend to give engagement with regional stakeholders a greater priority compared to more established ones (Uyarra, 2010). Huggins, Johnston, and Stride (2012) also found that more established universities in the UK were more likely to interact with a more diverse range of organisations and with organisations located outside their own region. The latter was also true for universities located in more competitive regions.

The studies reviewed above emphasise the complex and multi-layered nature of universities' third mission, evidenced by the diverse KE activities they undertake, and the many relations they forge over time with different partners. This study aims to provide a contextualised understanding of the above propositions by analysing the nature of the third mission, in terms of the breadth of KE activities and stakeholders involved, across different types of universities in England over the years. England, and the UK as a whole, is characterised by a large and diverse Higher Education sector, and a long-standing policy interest in incentivising the third mission of universities.

Since the late 1990s the UK government has sought to encourage university–society interactions by funding third mission activities at universities. The main vehicle for KE policy in England has been a series of funding allocated to individual Higher Education institutions (HEIs) including the Higher Education Innovation Fund (HEIF). These policy efforts, and the more recent emphasis on generating research impact, has led universities to increase their focus on delivering benefits from research and brought about a considerable expansion of KE infrastructure and capabilities in HEIs (PACEC, 2009), including the setting up of intermediaries such as technology transfer offices in order to exploit academic outputs and facilitate the knowledge and technology transfer from universities to the private sector (Dexter, Bennett, & Leseure, 2007).

Universities in the UK have also been encouraged to facilitate KE in their regions, supported by regional policies and institutions such as regional development agencies and other intermediaries from the late 1990s and throughout the 2000s (Goddard & Chatterton, 1999; Kitagawa, 2004; Uyarra, 2010). The regional development agenda in England lost momentum however, with the abolition of the English Regional Development Agencies (RDAs) in 2010 and their replacement with smaller and less resourced Local Enterprise Partnerships (LEPs). In addition, the financial and economic crisis (Goddard, Coombes, Kempton, & Vallance, 2014; Hutton & Lee, 2012), led to knock-on effects on universities through reduced investments in innovation of the private sector, and public sector budgetary constraints, reducing demand for services such as consultancy (Charles et al., 2014). Similarly, Higher



Education in England underwent further reforms since 2012 with a drastic reduction in teaching-related public funding and the introduction of higher tuition fees for home and European Union (EU) students. These changes in the institutional and economic landscape led to a widely differentiated institutional vulnerability affecting both universities and places (Goddard et al., 2014).

### 3 | CONTEXT, EMPIRICAL DATA AND METHODOLOGY

#### 3.1 | UK Higher Education sector: Organisational context

The UK Higher Education system is diverse for historical reasons (Goddard et al., 2014; Scott, 2014). These differences can be traced back to the medieval origins of universities such as Oxford and Cambridge, the civic universities created in industrial cities during Victorian times, and subsequent waves of expansion and reform, including the creation of red brick universities during the inter-war years, and new universities in the 1960s and the subsequent incorporation of the Colleges of Advanced Technology in the university sector.

A binary divide (McCormack, Propper, & Smith, 2014) is therefore often made within the UK Higher Education sector between the old universities, founded before 1992, which are typically more research focused, and new universities which were granted university status after 1992 as a result of the Further and Higher Education Act (HMSO, 1992), and also former university colleges that have become universities in recent years. New universities tend to be more teaching focused, and their third mission activities are assumed to be locally oriented given their traditional focus on vocational education and training, and their relatively low engagement in basic research (Charles et al., 2014; Goddard et al., 2014; De la Torre et al., 2018). Boliver (2015) indeed found large differences between the old pre-1992 universities and the new post-1992 universities in terms of research activity, economic resources, academic selectivity and social mix.

However, there is also arguably a further divide between the 24 most research-intensive older universities (known as the Russell Group) and other older universities, and also between newer universities that were former polytechnics (which offered higher diplomas and degrees, often in more technical subjects, that were governed and administered at the national level) and those that were previously further education colleges (McCormack et al., 2014). Given the heterogeneity that exists within the Russell Group of universities (see, e.g., Boliver, 2015) and particularly the dominance of a small number of top universities, sometimes a more fine-grained distinction is made between the latter and the rest of the Russell Group.

In this paper we therefore consider five categories of HEIs based on the historical development and research intensity (see Appendix 1). Within the group of old universities we distinguish three categories: the Top Five, the rest of the Russell Group, and others.<sup>3</sup> The Russell Group universities represent less than 15 per cent of the sector in terms of the number of universities but capture around 75 per cent of the total quality-related research (QR) funding granted by Higher Education Funding Council (HEFCE) to universities.<sup>4</sup> We treat the Top Five universities (Imperial College, Universities of Cambridge, Oxford, Manchester and University College London) as a separate group from the rest of the Russell Group based on the distribution of research funding: these five universities receive a disproportionate share of QR funding by HEFCE (32% in 2014–15). Within the new universities, two groups are identified: former polytechnics consisting of HEIs which were originally established as polytechnics under local authority funding and control, and converted to university status since 1992, and 'other new universities and HEIs', which includes HEIs that were granted university status after 2004, primarily former Further and Higher Education colleges, specialist colleges and current Higher Education colleges.

While acknowledging the limitations of adopting such broad categories, the different groups of universities capture the diverse nature of Higher Education sector in England and are consistent with other studies highlighting the institutional differences across the sector. For example, Boliver (2015) concludes that a binary divide persists between old (pre-1992) universities, characterised by higher levels of research activity, greater wealth, more academically successful and socioeconomically advantaged student intakes, and newer (post-1992) institutions.



McCormack et al. (2014) suggest that research-intensive universities see themselves competing in international and national markets (for staff and students) while newer universities focus more on local markets. This is consistent with De la Torre et al. (2018)'s findings of a long-standing division between traditional universities and former vocational education institutions, in terms of specialisation, teaching and research intensity, and stakeholder engagement.

### 3.2 | Source of information and variables

Our analysis draws on Part B of the HEBCI Survey for the academic years 2003/4 to 2011/12. HEBCI is an annual survey carried out since 2001, now administered by the Higher Education Statistics Agency. The questionnaire collects data on a broad range of third mission activities encompassing the contributions of universities to both economy and society, covering all the HEIs in England, Scotland, Wales and Northern Ireland. More specifically, HEBCI collects information on a range of third mission or third stream activities, defined there as: a set of selected knowledge exchange (KE) activities in which a university/HEI strategically engages as an institution.

The key KE activities used in this paper are: collaborative research (collaborations), consultancy (consultancy), contract research (contracts), facilities and equipment related services (facilities), continuing professional development and continuing education (CPD), IP activities including shares, sales (patents and licences) and spin-offs (spin-offs). These activities are frequently used in the literature to capture the relationship between universities and other actors in the society (see for example Hewitt-Dundas, 2012 or Guerrero et al., 2015). Table 1 presents a detailed description of the selected variables for the analysis as well as descriptive statistics for the whole period. Due to differences in the nature of the variables, our analysis uses normalised variables by year.<sup>5</sup>

We examine 107 out of the 130 English HEIs (176 in the UK) covered in the HEBCI survey. We exclude from the analysis HEIs for which no information was available for the whole time-window as well as those HEIs solely specialised in Arts and Design. In terms of the institutional types described in previous section, the breakdown of our population is as follows: 45.8 per cent pre-1992 universities (5% Top Five, 14% Other Russell Group and 27.1% Other Old) and 54.2 per cent post-1992 universities (29% Former Polytechnics and 25.2% Other New HEIs). Within these types, and in order to contextualise our findings, we complement our results with some illustrative examples of third mission strategies produced by universities.<sup>6</sup>

### 3.3 | Methodology for empirical analysis

In order to better understand the evolution of KE activities, we employ two quantitative techniques. First, we perform a factor analysis based on a principal components technique with Kaiser Normalisation (Hair, Anderson, Tatham, & Black, 1998) to extract different modes of KE interaction by universities (Appendix 2 includes results of the factor analysis). We calculate the factor scores based on a least squares regression approach in order to predict the location of each individual on the factor (Thurstone, 1935). Under this process, the computed factor scores are standardised to a mean of zero and the standard deviation equal to one because the principal components method is used (DiStefano, Zhu, & Mindrila, 2009; Tabachnick & Fidell, 2001). Conceptually, factor scores represent the degree to which each university scores high on the group of items with high loadings on a factor. Thus, higher values of the variable with high loadings on a factor will result in a higher factor score (Hair et al., 1998). Subsequently, the standardised factor scores obtained are represented in a line chart in order to characterise the evolution of third mission interactions across universities. This information is used also to understand how universities prioritise their third mission engagement, including the ways in which they have shifted their focus and strategic activities over the years (third dimension of the model).

Second, the evolution of KE activities of universities is captured by means of temporal graphs depicting (a) the annual growth rates in income from different types of actors involved and (b) the share of regional income out of all income from KE. With this information, we look at the actors and the regionally embedded activities. The

TABLE 1 Definition of variables, descriptive statistics<sup>a</sup> and factor analysis

Variable (factor loadings)	Definition	Mean	Std dev.	Min.	Max.	Factors
£ Collaborations	Total income from collaborative research involving both public funding and funding from business (£000s)	5,173.82	9,089.56	0	67,326	Research-oriented activities
# Contracts	Total number of contract research, excluding any already returned in previous variable (£ Collaborations) and Research Councils	206.21	315.64	0	2,591	
£ Contracts	Total value of contract research, excluding any already returned in previous variable (£ Collaborations) and Research Councils (£000s)	7,158.36	14,628.23	0	124,583	
Patent app	Number of new patent applications filed in year by or on behalf of the HEI	13.34	28.76	0	298	Consultancy
Patent grant	Number of patents granted filed in year by or on behalf of the HEI	4.73	14.11	0	175	
# Licences	Total number of non-software and software licences granted	378.86	1,074.71	0	9,822.6	
£ Licences	Total revenues from IP income	32.09	107.32	0	1,729	Facilities
# Consultancy	Total number of consultancy contracts	474.74	1,750.93	0	17,846	
£ Consultancy	Total value of consultancy contracts (£000s)	2,476.34	3,943.18	0	32,064.53	
# Facilities	Total number of facilities and equipment related services	134.95	300.97	0	4,186	Training
£ Facilities	Total value of facilities and equipment related services (£000s)	810.79	1,612.94	0	11,485.32	
# CPD	Courses for business and the community—CPD courses and CE: Total learner days of CPD/CE courses delivered	28,855.27	64,295.17	0	758,340	
£ CPD	Courses for business and the community—CPD courses and CE: Total revenue	4,067.89	5,196.29	0	35,803.23	Spin-off
Spin-off	Number of spin-offs established with some HEI ownership	1.16	2.29	0	20	
Spin-off NHE	Number of formal spin-offs established with no HEI ownership	0.17	0.66	0	8	

<sup>a</sup>Monetary variables are deflected using 2003/04 as reference value. Number of observations: 963.

average annual growth rate (AGR) is calculated by dividing the slope by the income. The slope is determined by the regression line formed by the matrix corresponding to the years of study 2003/04–2011/12 and income raised by the universities by the type of partners.

## 4 | RESULTS

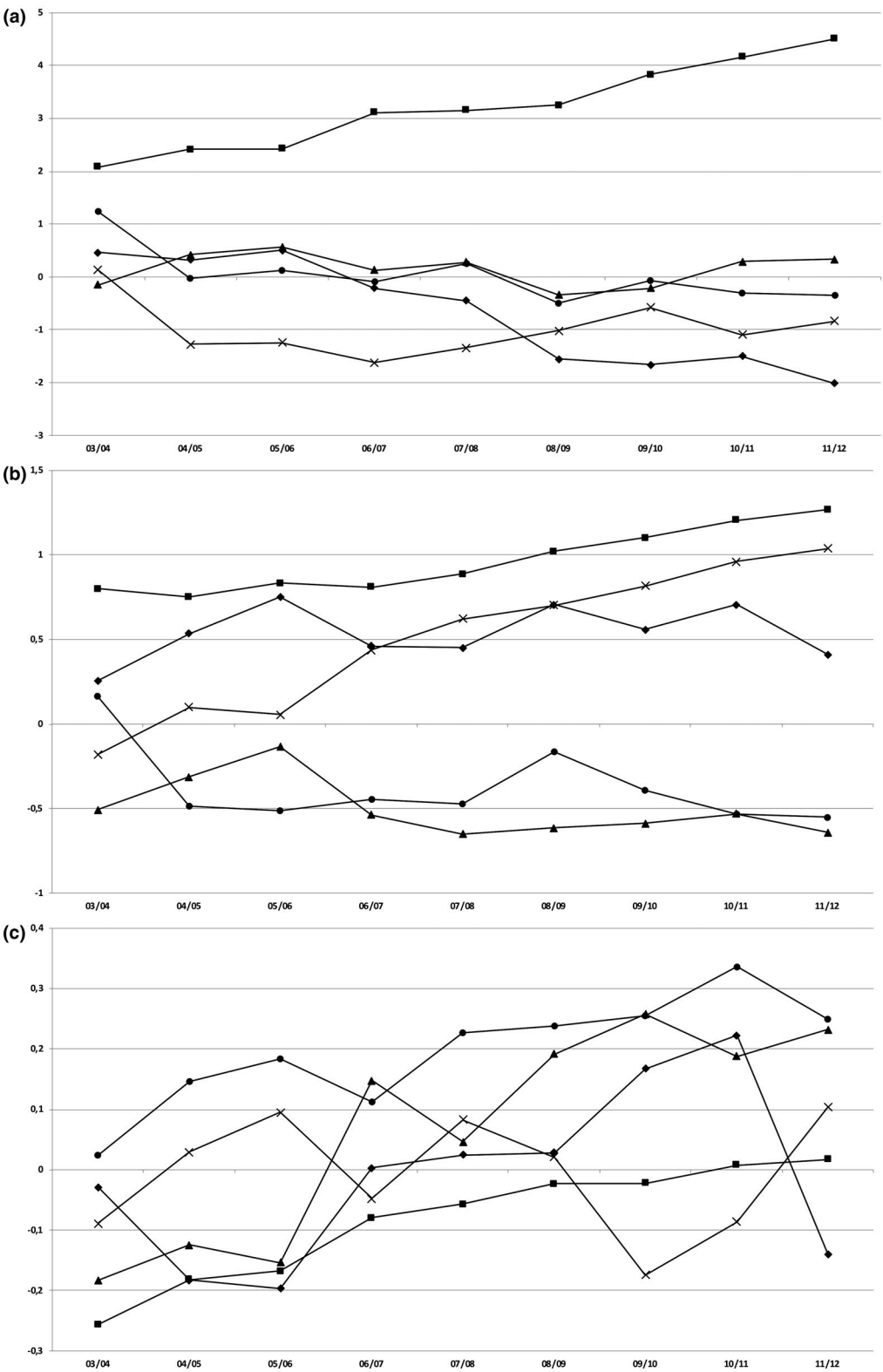
### 4.1 | Different forms of KE

Our factor analysis<sup>7</sup> of KE activities yields five different categories, namely: research-oriented activities, facilities, consultancy, training and spin-offs (Table 1, last column). The five factors explain almost 70 per cent of the total data variability, which is considered as satisfactory for social science studies (Hair et al., 1998). In order to check the factors' internal reliability, we calculate the Cronbach alpha index. The coefficients for all groups are around 0.6,<sup>8</sup> which is also considered as a satisfactory value (Hair et al., 1998). This categorisation of university activities offers a more nuanced approach to the grouping of KE activities compared to broader categories used in the literature such as soft/hard activities (Philpott et al., 2011), commercialisation activities (Abreu & Grinevich, 2013; Huyghe & Knockaert, 2014; Jain, George, & Maltarich, 2009) or entrepreneurial activities (Guerrero & Urbano, 2012; Guerrero et al., 2015) and is in line with the approach from Hayter et al. (2018) suggesting the broad variety of well-established pathways for KE.

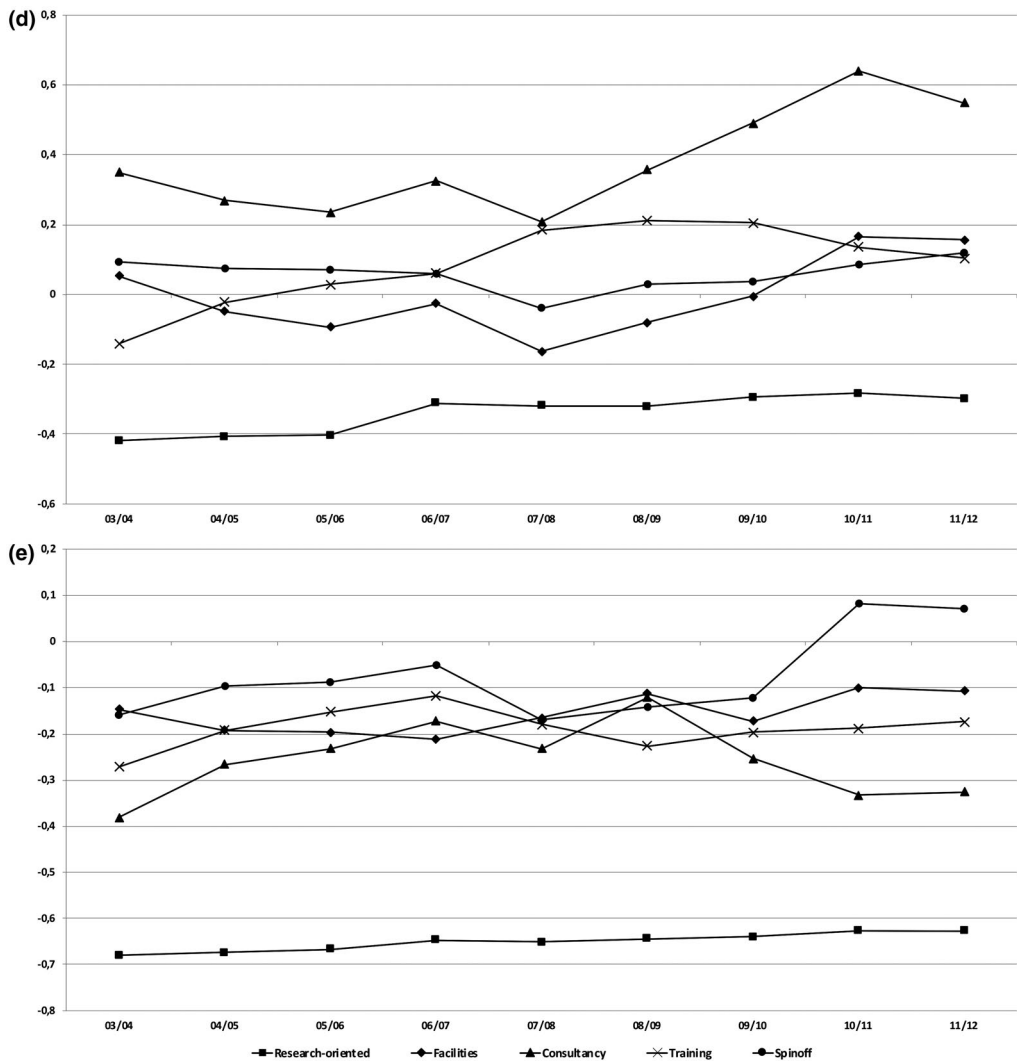
In order to understand the evolution of interactions by different types of universities, the obtained factor scores are graphically described in Figure 1(a)–(e) and described in the sections below. The results show how different types of HEIs engage in different mixes of KE activities over time. The figures present standardised values and positive (negative) values of factor scores can be interpreted as the number of standard deviations of each group of universities in specific KE activities (factors). The higher the standard deviation is, the higher the distance with the population average and the more focused universities are in this particular activity compared to others. These standard deviations illustrate how efforts of universities vary within the Higher Education sector but also how universities have re-configured and changed their third mission activities over the years.

As shown in Figure 1, Russell Group universities are more focused on research-oriented KE activities such as collaborative research, contract research and generation of IPs, which clearly distinguish themselves from the rest of HEIs because they are the only group with positive standard deviations for these activities. However, results suggest that within the Russell Group there are some differences. While the Top Five universities (Figure 1a) show an increasingly pronounced focus on research-oriented activities compared to the other groups, The Rest of the Russell Group universities are not so specialised (standard deviation is close to 1 for the full period), balancing instead different activities and using facilities and training increasingly as forms of engagement (Figure 1b). This specific research-oriented mission of some Top Five universities is evident in their third mission strategy. For instance, the University of Manchester strategically integrates translational research and IP exploitation as part of research activity instead of separating them as third mission.<sup>9</sup>

'Other Old' universities do not stand out in any factor (Figure 1c) and they reflect a mix of entrepreneurial activities throughout the entire period as their factor scores are very close to the population average for all the activities (values close to 0). A possible explanation for this finding is that within the Other Old universities, historically two types of institutions can be distinguished, both of which were founded during the 1960s. One type comprises the 'plate glass universities' founded in the 1960s (e.g., Aston, Essex, Lancaster, Sussex, Warwick,<sup>10</sup> York) and the former Colleges of Advanced Technology that were converted into universities in the 1960s (e.g., Brunel, Cranfield, Loughborough). This latter group of universities show certain entrepreneurial characteristics with their strong historical links with industry partners. These universities tend to be relatively small and, in their KE strategies, demonstrate a wide range of KE activities as strategic areas, including collaborative research and exploitation; CPD; delivering high levels of graduate employability, entrepreneurial behaviour and enterprise; and innovative supports for SMEs and new business. This feature supports the findings from the HEBICI data showing a broad range of KE activities with low specialisation.



**FIGURE 1** Evolution of third mission activities by university cluster: (a) Top Five, (b) The Rest of Russell Group, (c) Other Old, (d) Former Polytechnics, (e) Other New. Left axes include factor scores from factor analysis



**FIGURE 1** (Continued)

Post-1992 universities exhibit quite different behaviour: in general, they focus on all activities, but less so on the more research-oriented ones (they have the lowest standard deviations for these activities). Within this group, Former Polytechnics have increased their efforts in consultancy since 2007/08 (Figure 1d), while Other New HEIs appear to have accelerated the development of university spinoffs particularly in the last two years (Figure 1e).<sup>11</sup> Institutional strategy presents clearly focused and defined areas of KE activities, for example, the University of Derby (Other New), which demonstrates a strong focus on work-based learning with business partners, and has a strategic target on student start-ups by linking the employability agenda and inclusivity as an institution.

We thus observe that English HEIs seem to be intensifying their selectivity and specialisation in particular types of KE activities. Universities learn, build relationships with the partners and gain legitimacy in engaging certain types of activities over time. Research-intensive universities have, in the period studied, increased their share of income from research-oriented KE activities, as well as harder commercial activities such as licensing. New and generally less research-intensive universities have increased their share of KE income from softer activities such as consultancy and facilities.

**TABLE 2** Annual growth rates in KE income by type of partner

Type of university	Partner	Annual growth rate	Annual growth rate	Annual growth rate
		2003/04–2011/12 (AGR)	2003/04–2007/08 (AGR1)	2007/08–2011/12 (AGR2)
Top Five	SMEs	0.3%	–5.5%	6.3%
	Non-SMEs	5.0%	4.8%	4.1%
	Non-commercial	16.0%	25.5%	10.0%
	<b>Total</b>	<b>10.3%</b>	<b>12.9%</b>	<b>7.4%</b>
	% SMEs/Total <sup>a</sup>	–11.2%	–17.7%	–0.9%
	% Regional/Total <sup>b</sup>	–5.1%	3.4%	–11.8%
	Regional <sup>c</sup>	6.3%	17.1%	–3.1%
The Rest of Russell Group	SMEs	2.5%	6.2%	–0.5%
	Non-SMEs	2.4%	0.5%	4.3%
	Non-commercial	7.2%	4.9%	7.3%
	<b>Total</b>	<b>5.5%</b>	<b>3.7%</b>	<b>5.9%</b>
	% SMEs/Total	–2.8%	2.6%	–6.5%
	% Regional/Total	–0.5%	4.0%	–4.3%
	Regional	4.7%	5.8%	3.9%
Other Old	SMEs	1.6%	4.6%	–0.7%
	Non-SMEs	–0.6%	8.1%	–7.8%
	Non-commercial	4.2%	4.6%	6.8%
	<b>Total</b>	<b>1.9%</b>	<b>6.1%</b>	<b>0.1%</b>
	% SMEs/Total	–0.4%	–1.8%	–0.7%
	% Regional/Total	2.7%	7.4%	–4.0%
	Regional	2.7%	7.4%	–2.0%
Former Polytechnics	SMEs	7.5%	19.5%	–5.1%
	Non-SMEs	1.9%	0.0%	3.2%
	Non-commercial	5.0%	10.8%	–1.3%
	<b>Total</b>	<b>4.8%</b>	<b>9.9%</b>	<b>–1.1%</b>
	% SMEs/Total	3.1%	8.8%	–4.0%
	% Regional/Total	–0.9%	2.0%	–4.8%
	Regional	4.4%	18.9%	–7.1%
Other New	SMEs	0.5%	–0.5%	6.7%
	Non-SMEs	–4.2%	3.2%	–12.7%
	Non-commercial	2.4%	11.0%	–4.0%
	<b>Total</b>	<b>0.9%</b>	<b>7.4%</b>	<b>–3.4%</b>
	% SMEs/Total	–0.5%	–7.5%	10.1%
	% Regional/Total	–10.4%	–7.6%	–8.8%
	Regional	–2.4%	3.2%	–2.8%

(Continues)

TABLE 2 (Continued)

Type of university	Partner	Annual growth rate	Annual growth rate	Annual growth rate
		2003/04–2011/12 (AGR)	2003/04–2007/08 (AGR1)	2007/08–2011/12 (AGR2)
Total	SMEs	2.8%	6.1%	–1.2%
	Non-SMEs	2.6%	3.9%	1.4%
	Non-commercial	8.5%	9.9%	6.6%
	<b>Total</b>	<b>6.0%</b>	<b>7.4%</b>	<b>4.4%</b>
	% SMEs/Total	–3.2%	–1.2%	–4.9%
	% Regional/Total	–2.3%	0.7%	–5.4%
	Regional	4.1%	9.7%	–0.3%

<sup>a</sup>%SMEs/Total = proportion of SMEs income over the total income from partners.

<sup>b</sup>% Regional/Total = proportion of regional income over total income from private partners (SMEs and non-SMEs).

<sup>c</sup>Regional = regional income from private partners (SMEs and non-SMEs).

## 4.2 | Stakeholders involved in KE activities

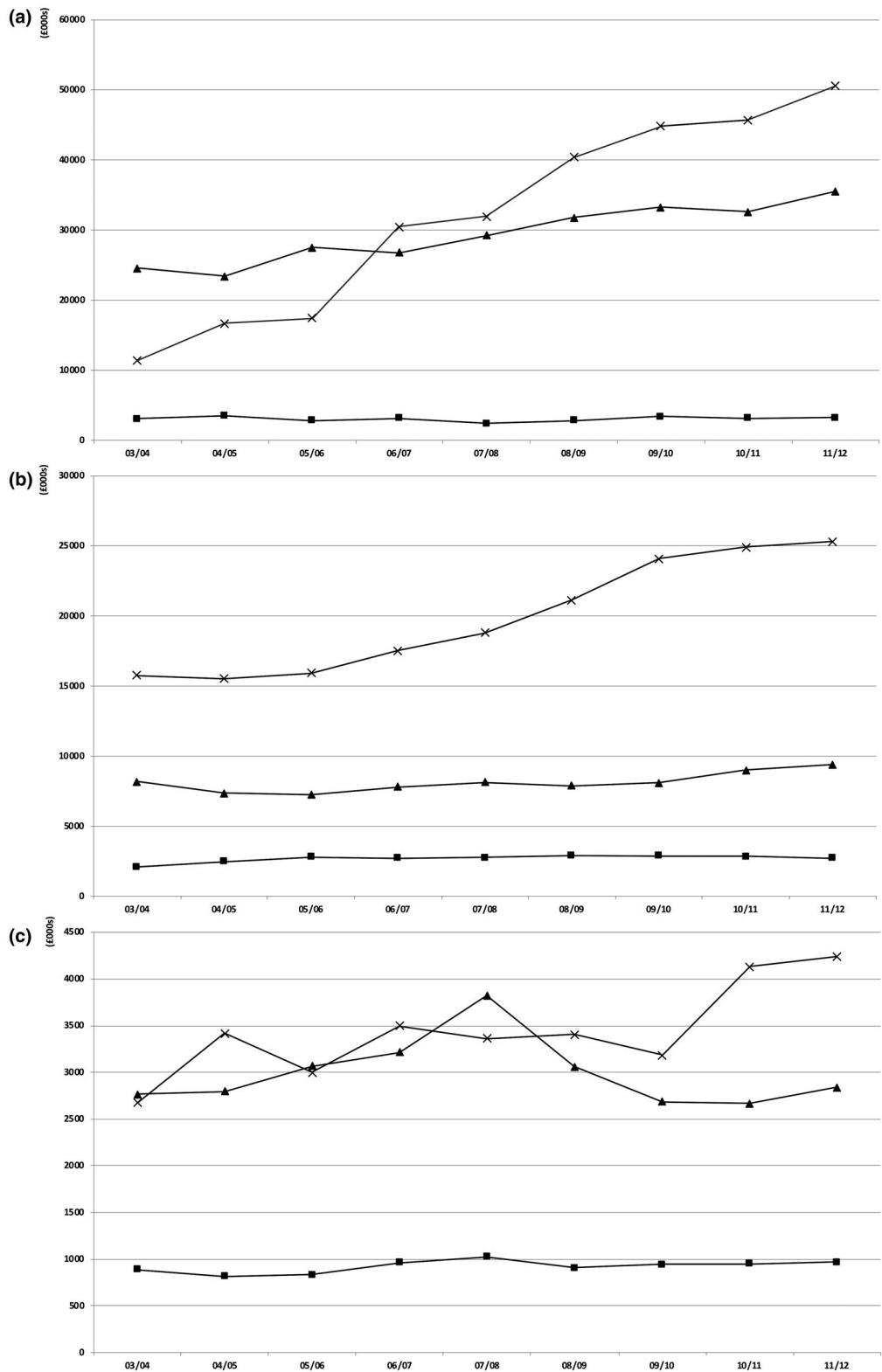
The picture of an increasingly differentiated Higher Education sector is reinforced when we analyse the evolution of KE activities with different types of non-academic partners. In order to do this we distinguish the income derived from different types of stakeholders in the studied period. Specifically, we analyse differences in interactions between universities and SMEs, non-SMEs and non-commercial organisations—such as government bodies and third sector organisations—using the information on income from collaborative research, contracts, consultancy, facilities and licences (see Table 2 for more details).<sup>12</sup> Income evolution is presented in Figure 2a–e. We also calculate the evolution of the total income coming from the interaction with each mentioned partner as well as the annual growth rate for the full period (AGR) and for two sub-periods: 2003/04–2007/08 (the period preceding the economic crisis, AGR1) and 2007/08–2011/12 (AGR2), see Table 2.

Within this overall trend, there are clear differences in engagement with different partner types. While income with all types grew during the period (6% overall), income from KE activities with non-commercial entities grew more on average than income with firms (8.5% and 2.5% respectively). In contrast, engagement with SMEs increased before 2007/08 and declined afterwards (–1.2%).

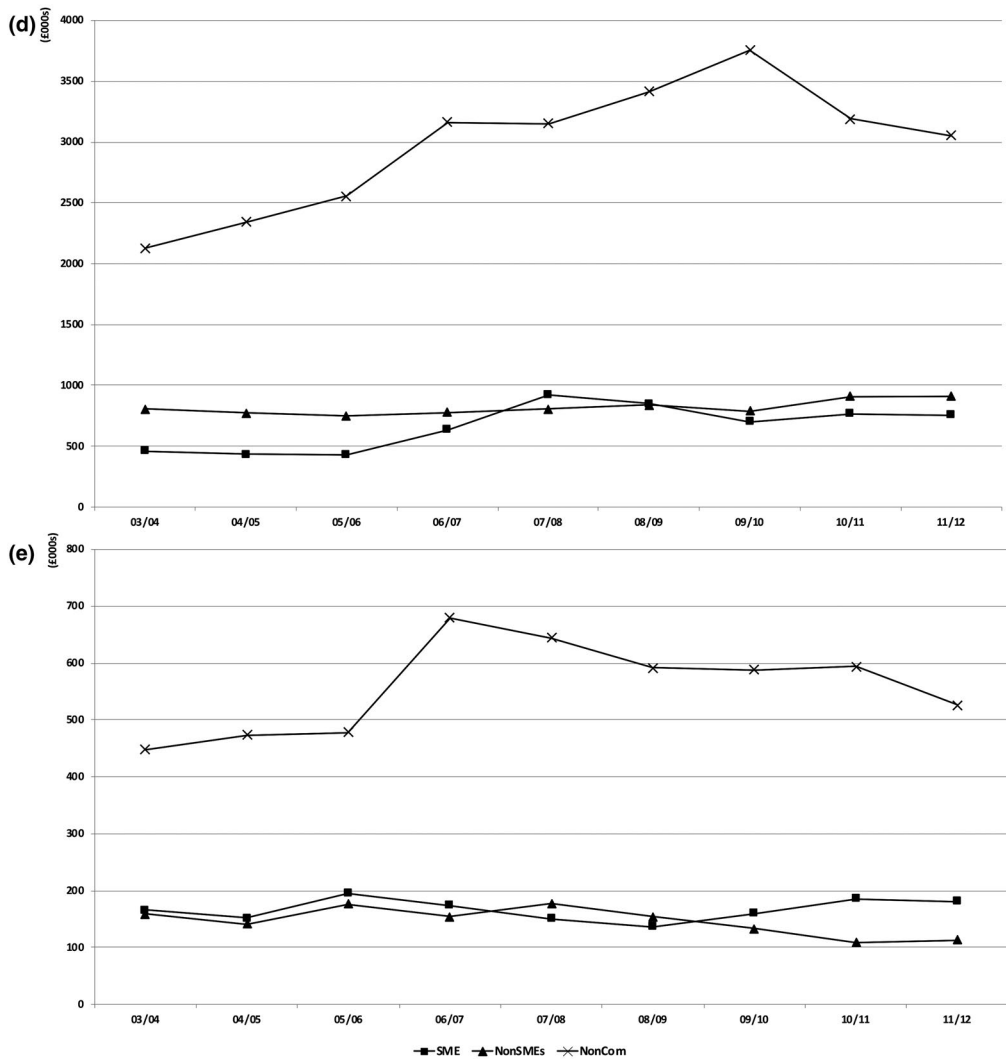
However, within this broad picture we can observe stark differences across institutional types. KE income increased in the period for all groups, particularly for Top 5 and the Rest of Russell Group universities (on average the annual growth has been 10.3% and 5.5% respectively). Russell group universities (Top Five and the Rest of Russell Group) exhibit the biggest growth in income from KE activities with non-commercial organisations (16% and 7.2% respectively) whilst Former Polytechnics experienced the greatest increase in income from SMEs (7.5% compared with less than 2.5% for other universities). Top Five universities benefited from the largest increase in income from large firms (5%), while Other New universities experienced the biggest drop in KE income from large firms (–4.2%). Consequently, some of the new universities started to take an explicit strategy to reach out to new private sector clientele in specific fields, like the case of Middlesex University, as a response to the decline in funding from large firms as well as public sector organisations.<sup>13</sup>

Although growth patterns in KE income remained positive for Russell group universities after 2007/08 (particularly for the Top Five), the rest display low (for Other Old universities) or even negative income growth (for post-1992 universities). This slow or negative growth is explained mainly by a drop in KE income from large firms (particularly in the case of Other New and Other Old universities) and SMEs (particularly for Former Polytechnics).





**FIGURE 2** Evolution of income across actors in KE activities across HEIs: (a) Top Five, (b) The Rest of Russell Group, (c) Other Old, (d) Former Polytechnics, (e) Other New. Figures include income from the following KE activities: contracts, consultancy, facilities and licences



**FIGURE 2** (Continued)

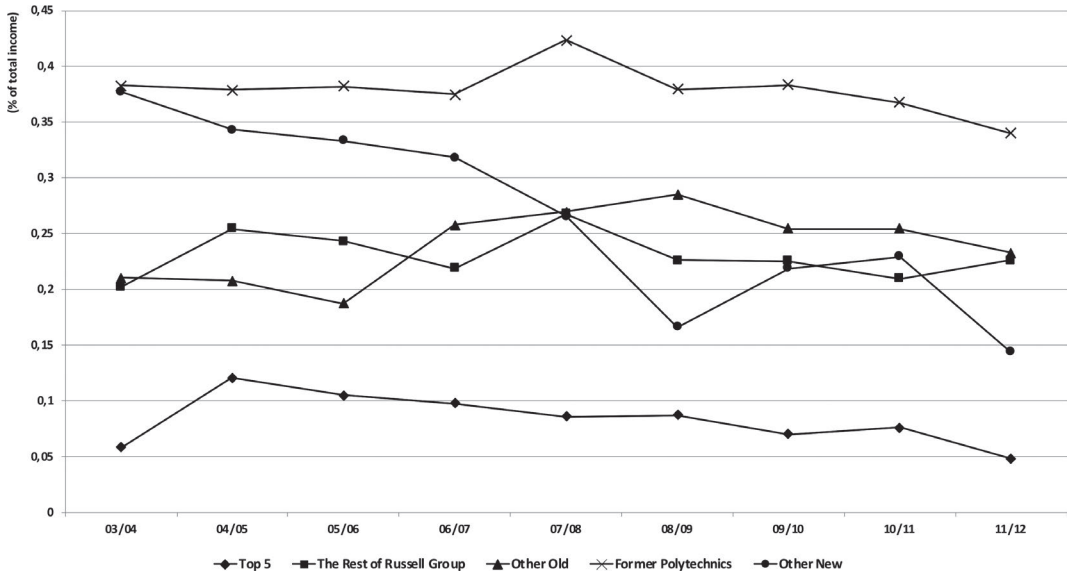
Other New universities also experienced a significant reduction in KE income from non-commercial organisations (–4% compared with an 11% increase in the previous period considered).

Our analysis shows a significant drop in income growth from all actor types, namely, SMEs, large firms and non-commercial organisations, from 2007/08 onwards. The decline in income from KE interactions with firms (industry helix) and non-commercial organisations (the government helix) may reflect the effects of the economic crisis and the following public sector funding cuts. This reduction is particularly severe for newer universities, which tend to be reliant on KE income from SMEs and public sector organisations, particularly at the local level. The trend towards greater selectivity and differentiation has intensified since 2007/08, which coincides in time with the economic slowdown as well as with a series of policy changes influencing regional development and Higher Education landscapes in England as described in Section 2.

This once again shows that old and more research-intensive universities appear to exhibit greater resilience and adaptation to policy changes and economic conditions. They have been able to diversify their funding sources away from the public sector and towards private sector opportunities, for instance through strategic partnerships with large private firms.

This in turn has implications in terms of universities engagement with regional actors. In order to understand this, we conduct an analysis of the regional (share and total) KE income (from KE activities such as contracts, consultancy, facilities and licences). Results are presented in Figure 3. In addition, the AGR is estimated for the regional KE income as well as for its share of the total KE income (see also Table 2). The data shows a slight increase (4.1%) of income from regional interactions in the full period, however the regional share of the total income decreased by 2.3 per cent. Further, we can observe stark variations in the two periods analysed. The positive trend (9.7%) in engagement with regional stakeholders in the first period (2003/04–2007/08) contrasts with a reduction of the regional income for HEIs of around –0.3% after the crisis. All universities exhibited a positive growth of regional KE income in the first period, with Former Polytechnics being the ones with the higher growth (18.9%), followed by Top Five universities having increased regional income by 17.1 per cent. The decline has been shaper in recent years with the exception of the Rest of Russell Group that is the only group with a positive growth in both periods (5.8% in 2003/04–2007/08 and 3.9% in 2008/09–2011/12). For the rest, after 2007/08 all groups reduced their interaction with regional actors, both in terms of their overall regional engagement and as a proportion of total KE income (see Figure 3). This decline in the total and the share of regional engagement has been particularly marked for Former Polytechnic universities (–7.1% and –4.8% respectively) and Top 5 (–3.1% and –11.8%).

We can therefore observe that while total income rose markedly in the period, this was dominated by non-regional interactions, particularly in the period after the crisis. In turn, regional relations differ markedly across university types. Russell Group universities perform a smaller proportion of their KE activities in their region compared to other universities such as former polytechnics. This is not to underestimate the contribution of the former to the regional economy via KE activities which amounted to a combined income of near £14 million. However, we found that the relative importance of the region in KE diminished in the period for all universities, particularly for Top 5 universities but also, more surprisingly, for new universities traditionally considered to be more locally oriented. These universities have been more affected by public spending cuts, which translate into diminished



Income/year	03/04	04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12
Top 5	1,557.8	4,585.0	4,149.7	4,975.7	4,803.0	5,991.3	5,343.9	6,012.3	3,978.0
Rest of Russell G	5,909.3	7,467.2	7,295.1	7,084.0	8,204.1	8,043.8	8,849.0	8,581.5	9,637.3
Other Old	1,662.4	1,490.0	1,328.2	1,946.7	2,063.9	1,977.0	1,675.3	1,792.8	1,963.1
rmer Polytechn	1,038.9	1,218.8	1,216.2	1,842.7	2,139.4	1,761.3	1,628.2	1,637.1	1,579.7
Other New	232.5	289.9	363.6	375.2	238.4	288.9	291.8	234.7	229.3

**FIGURE 3** Evolution of regional income in KE activities across HEIs

resources to fund KE (particularly with SMEs) and lower demand for KE by the public sector, particularly by local government, and by changes in the governance of economic development in England. Locally oriented Former Polytechnics faced greater vulnerability as a result of policy changes including the disappearance of RDAs, whilst research-intensive universities are able to rely on other sources within and beyond regional boundaries (Charles et al., 2014). Despite this landscape, in the university strategy documents, Former Polytechnics demonstrate a strong commitment to local economic development agenda and engagement with local SMEs, seizing this as a new opportunity, especially at the time other support mechanisms are disappearing. On the demand side, firms and the public sector may have also responded to the economic crisis by refocusing their knowledge sourcing strategies and being more selective in their interactions with a fewer number of universities, or reducing their KE activities altogether (see Coates-Ulrichsen, 2014).

## 5 | CONCLUSIONS

Universities are undergoing a second academic revolution incorporating the third mission of economic development. Although government policy pressures seem to push universities to become isomorphic institutions (DiMaggio & Powell, 1983) following the model of the entrepreneurial university (Clark, 1998; DiMaggio & Powell, 1983), empirical studies suggest a large heterogeneity in universities' entrepreneurial transformation (Huyghe & Knockaert, 2014; Jacob et al., 2003; Martinelli et al., 2008). This paper suggests that, despite these isomorphic macro environment and policy pressures, different types of universities respond differently to these external macro environment demands (Hayter, 2015).

Using data from the HECI Survey for the academic years between 2003/4 and 2011/12, the paper analysed the changing dynamics of the third mission in English HEIs in relation to the evolution of KE activities and the actors involved in the interactions. The analysis confirms that, in the last decade, the entrepreneurial behaviour of universities in England is marked by increasingly differentiated patterns, diverging from the one-size-fits-all model of the entrepreneurial university. By analysing five distinctive clusters of English HEIs we indeed observe a very diverse picture. In general Russell Group universities are more focused on research-oriented activities such as collaborative research, contract research and generation of IPs, typically in partnership with large firms and non-commercial organisations. Other universities are either not specialised, or focused on activities closer to training and consultancy. Within the latter, former polytechnic HEIs tend to collaborate more with SMEs, particularly within their region.

The work makes two specific contributions to the literature on the entrepreneurial university. From a theoretical perspective, the paper provides a holistic view of university–society KE. The observed evolution in the third mission activities is arguably both the result of macro-level external pressures including the government third mission policy and micro-level institutional practices and strategic prioritising of individual universities recognising their own entrepreneurial opportunities (Hayter, 2015). Universities are perceived to be part of international hierarchies of academic distinction with different strengths and varying resources. At the same time, different types of universities in different geographical contexts have been exposed to different market opportunities and social expectations, as well as varying degrees of vulnerability (Goddard et al., 2014).

This paper highlights the importance of considering the temporal dimension in the analysis of the entrepreneurial university. This is because the evolution of third mission can be seen as the product of universities' cumulative experiences and conscious efforts over the years to improve capabilities and build up resources for specific KE activities, and relationships with selected partners around these activities. Each university is a path-dependent product of a distinct social, economic and institutional development process. Universities adopt different configurations of activities, which can be seen as the result of changes in their internal capabilities, traditional trajectories and surrounding structural and functional changes (Wittrock, 1993). Our findings echo previous studies confirming that there is no one model of the entrepreneurial university (e.g., Benneworth et al.,

2016; Hewitt-Dundas, 2012; Hussler et al., 2010; Philpott et al., 2011; Sánchez-Barrioluengo, 2014; Sánchez-Barrioluengo & Benneworth, 2019), but further complement them by taking a longitudinal view of third mission performance over time. While previous studies have provided cross-sectional evidence of a differentiated HEIs picture (De la Torre et al., 2018) we show that universities have become even more differentiated over time. We do this by also providing a more fine-grained differentiation between university types that goes beyond dichotomous types (e.g., high vs. low research intensive; and old vs. new universities), and beyond a narrow commercialisation focus to consider a broad range of KE activities.

Some policy and managerial implications emerge from this empirical study for HEIs in the UK and beyond. First, in terms of Higher Education policy, while the UK government (e.g., Sainsbury, 2007) recognises the diversity of the sector and the importance of HEIs to make their own strategic choices to invest in and develop KE activities, the formula-based third mission funding system in England (see Coates-Ulrichsen, 2014; Rosli & Rossi, 2016) is highly skewed in favour of a few elite and large research intensive universities. Consequently, even if the diversity is recognised at the system level, certain universities' third mission strategies and practices may be compromised, as they are not well positioned to diversify their income base. At the same time, increased concentration of research funding, and the differential impacts (and uncertainties over the future) of the English university tuition funding model are negatively impacting the financial sustainability of some HEIs. Our findings are consistent with those of De la Torre et al. (2018), namely that HEIs are likely to be 'locked' for a long time in particular configurations of resources, activities and priority stakeholders. Resource constraints and policy pressures may make some universities quite vulnerable while other, better resourced universities would be better positioned to diversify across different activities, partners and geographic interactions. Second, in terms of regional development policy, increased concentration of funding in particular types of HEIs, combined with the reduction of incentives for regional and SME engagement, may constrain universities' capability and resources to address specific economic and social needs, particularly in their local areas, thus potentially aggravating regional disparities in innovation and economic growth. Given that SMEs account for the majority of the UK business population and are key drivers for new jobs and innovative technologies, a worrying trend can be observed in terms of engagement with SMEs and in terms of local and regional engagement, which has diminished substantially in the last period, coinciding with the economic crisis and the abolition of the English RDAs. While place vulnerability would depend on the local dependence of Higher Education and the number and mix of universities located in a particular territory (Goddard et al., 2014), measures are needed to ensure the continuing role of universities as partner and anchor organisation in their regions. The UK's ambition for local industrial strategies (BEIS, 2017) envisage a proactive engagement of universities in co-creating visions and resources with local authorities, businesses and communities to support innovation ecosystems. Different types of HEIs in a local area may need to work together to complement their strengths and capabilities and share resources for SME engagement.

A third and final reflection relates more generally to the need to balance the multiple, and often unrealistic, expectations regarding universities' roles within increasingly differentiated Higher Education systems. Policy actors need to recognise that there are different, equally valid approaches to creating societal contribution, and there is no one-size-fits-all model to be followed (Sánchez-Barrioluengo & Benneworth, 2019). Third mission policy (see also Molas-Gallart & Casto-Martínez, 2007; Molas-Gallart et al., 2002) needs to adopt a broader and more differentiated perspective taking in HEIs' strategies, their engagement with a variety of partners—not just firms but also government bodies, non-profit organisations and local communities, and their involvement in research-oriented and teaching-related interactions (see Goddard, Hazelkorn, Kempton, & Vallance, 2016; Kitagawa et al., 2016). Current third mission policies have relied too much on the research-third-mission nexus with its narrow conception of KE interactions, with insufficient focus upon the teaching/education-third-mission nexus (Siegel & Wright, 2015).

Finally, we acknowledge the limitations of this study, including the data limitations of the HEBCI Survey in terms of the quality and coverage of KE activities, which limits the extent of our comparative analysis. For instance, certain third mission activities such as individual consultancy income are difficult to capture at an institutional

level and thus the quality of data may be questionable. There is also limited understanding of the educational impact (Healey, Perkmann, Goddard, & Kempton, 2014) of university's collaborative relationships, including CPD, placements and other training activities universities engage with. Further, there are limitations related to the nature of metrics and how to measure the impact of KE activities, which would require further study (see Gertner, Roberts, & Chalres, 2011; Lockett, Wright, & Wild, 2015; Rossi & Rosli, 2015). Finally, the results presented here relate specifically to the dynamics of the third mission in England. Building on this, future extensions of the present study should incorporate other countries in the analysis to allow more generalisable results with a comparative perspective and with other econometric methods in order to infer additional recommendations. In addition, they could undertake a more granular understanding of HEIs by adopting a multi-level analysis taking in the role of individuals, organisational contexts and governance structures. Specific in-depth case studies could help to study the particularities emerging within each cluster group identified such as fluctuations in KE activities within the group of Other Old universities.

## ACKNOWLEDGMENTS

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## ENDNOTES

- <sup>1</sup> Hayter and Cahoy (2018) introduce a different angle and point out the emergence of multiple other missions. For example they discuss how the third mission has long been defined as public service engagement, while policymakers often speak of commercialisation and entrepreneurship as the fourth mission. They also highlight the emergence of sustainability as an important mission.
- <sup>2</sup> There is a growing interest among policy makers and academics in developing accurate methods for third mission measurement and benchmarking, aimed at capturing and fostering universities' performance, while accounting for their heterogeneity. There is also a challenge in terms of managing university ranking and league tables aiming to cover universities' performance across different dimensions of their missions (Montesinos, Carot, Martinez, & Mora, 2008).
- <sup>3</sup> English universities have experienced significant changes over time including name changes, mergers and their affiliations to mission groups, which poses challenges for longitudinal analysis. For instance, the universities of Durham, Exeter, York, and Queen Mary University of London became members of the Russell Group in 2012. We include them in the Russell Group in our analysis as it better reflects their historical evolution including the current situation.
- <sup>4</sup> HEFCE Annual funding allocations for 2013–14. Source: [www.hefce.ac.uk/funding/annalocns/1314](http://www.hefce.ac.uk/funding/annalocns/1314) [last accessed 24 April 2017].
- <sup>5</sup> In addition, income variables are deflated using 2003/04 as year of reference.
- <sup>6</sup> Individual HEIs in England submitted to HEFCE the *Higher Education Innovation Funding (HEIF) institutional strategies 2011–2015* in July 2011 depicting their KE strategies. The purpose of presenting these examples here is illustrative only (for further elaboration see Kitagawa et al, 2016).
- <sup>7</sup> Factor analysis was also carried out splitting the time-window in two periods 2003/4–2007/8 and 2007/8–2011/12 in order to evaluate whether the exogenous event of economic crisis can bias the model. Results maintain equally number of factors and include the same variables within each factor, except for licenses that appears mixed between research-oriented activities and training group in the last period.

- <sup>8</sup> Specific values are: .88 for Research-oriented activities; .586 for Facilities; .516 for Consultancy; .481 for Training and .522 for Spin-offs. Although some of them could be lower than the minimum recommended, the explanation is that this coefficient is a direct function of the number of items explaining the construct. In consequence, factors composed by few items obtain lower value of Cronbach alpha.
- <sup>9</sup> The University of Manchester, 'HEIF institutional strategies 2011–15', July 2011.
- <sup>10</sup> The University of Warwick, along with many of the glass plate universities, was an original member of the '1994 Group'. It is worth noting that Warwick was the only university in England studied by Clark's (1998) seminal work *Creating the Entrepreneurial Universities*. The University of Warwick joined Russell Group in 2008, which exemplifies the dynamic nature of university transformation, as well as the aforementioned challenges of using the institutional typology.
- <sup>11</sup> Complementary to the descriptive picture presented, we applied multivariate regression techniques to check the correspondence between KE activities (factors) and types of universities (clusters). Results in this case corroborate the existence of clusters of universities selecting specific mixes of KE activities: Top 5 and the Rest of Russell Group universities are positively and significantly associated with research-oriented activities; spin-offs with the cluster of Other Old; and consultancy and training activities are positively associated with former polytechnics while 'Other New' HEIs do not present any positive signs for any factor.
- <sup>12</sup> Income from CPD (related to training activities) is not included in this section because the HEBCI survey does not include information that corresponds to specific partners.
- <sup>13</sup> Middlesex University, *HEIF 2011–2015 institutional strategies*, July 2011.

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## APPENDIX 1 Universities included in each cluster

Top Five	The Rest of Russell Group	Other Old	Former Polytechnics	Other New HEIs
Imperial College of Science, Technology and Medicine	King's College London	Aston University	Anglia Ruskin University	Bath Spa University
The University of Cambridge	London School of Economics and Political Science	Birkbeck College	Birmingham City University	Bishop Grosseteste University College Lincoln
The University of Manchester	Queen Mary University of London	Brunel University	Bournemouth University	Buckinghamshire New University
The University of Oxford	The University of Birmingham	Cranfield University	Coventry University	Canterbury Christ Church University
University College London	The University of Bristol	Goldsmiths College	De Montfort University	Edge Hill University
	The University of Exeter	Institute of Education	Kingston University	Harper Adams University College
	The University of Leeds	London Business School	Liverpool John Moores University	Leeds Trinity University College
	The University of Liverpool	London School of Hygiene and Tropical Medicine	London Metropolitan University	Liverpool Hope University
	The University of Newcastle-upon-Tyne	Loughborough University	London South Bank University	Newman University College
	The University of Nottingham	Royal Holloway and Bedford New College	Middlesex University	Roehampton University
	The University of Sheffield	St George's Hospital Medical School	Oxford Brookes University	Royal Agricultural College
	The University of Southampton	The City University	Sheffield Hallam University	Southampton Solent University
	The University of Warwick	The Institute of Cancer Research	Staffordshire University	St Mary's University College, Twickenham
	The University of York	The Open University	Teesside University	The University of Bolton
	University of Durham	The Royal Veterinary College	The Manchester Metropolitan University	The University of Chichester
		The School of Oriental and African Studies	The Nottingham Trent University	The University of Northampton
		The University of Bath	The University of Brighton	The University of Winchester

(Continues)

## APPENDIX 1 (Continued)

Top Five	The Rest of Russell Group	Other Old	Former Polytechnics	Other New HEIs
		The University of Bradford	The University of Central Lancashire	The University of Worcester
		The University of East Anglia	The University of East London	University College Birmingham
		The University of Essex	The University of Greenwich	University College Falmouth
		The University of Hull	The University of Huddersfield	University College Plymouth St Mark and St John
		The University of Keele	The University of Lincoln	University of Bedfordshire
		The University of Kent	The University of Northumbria at Newcastle	University of Chester
		The University of Lancaster	The University of Plymouth	University of Cumbria
		The University of Leicester	The University of Portsmouth	University of Derby
		The University of Reading	The University of Sunderland	University of Gloucestershire
		The University of Salford	The University of West London	York St John University
		The University of Surrey	The University of Westminster	
		The University of Sussex	The University of Wolverhampton	
			University of Hertfordshire	
			University of the West of England, Bristol	

## APPENDIX 2 Results of the factor analysis (factor loadings)

	Research-oriented activities	Facilities	Consultancy	Training	Spin-off
£ Collaborations	<b>0.6068</b>	0.1428	0.3092	0.0663	0.2108
# Contracts	<b>0.7650</b>	0.3354	0.1280	−0.0256	0.1881
£ Contracts	<b>0.8582</b>	0.2549	0.0408	0.0071	0.1537
Patent app	<b>0.8944</b>	0.1445	0.0779	0.0333	0.1050
Patent grant	<b>0.8333</b>	0.1086	−0.0327	0.0336	0.0676
# Licences	0.4130	−0.3067	0.2460	0.4110	−0.2018
£ Licences	<b>0.7788</b>	−0.1066	0.0032	0.2332	0.0338
# Consultancy	−0.0798	−0.0063	<b>0.8537</b>	−0.0176	0.0773
£ Consultancy	0.3137	0.2675	<b>0.7001</b>	0.0448	0.0386
# Facilities	0.0983	<b>0.8025</b>	0.0784	0.0833	0.0299
£ Facilities	0.4187	<b>0.6961</b>	0.1453	0.0103	−0.0025
£ CPD	0.3092	0.0265	−0.0340	<b>0.7617</b>	−0.0314
# CPD	−0.1498	0.1043	0.0146	<b>0.7896</b>	0.0915
Spin-off	0.2548	0.1080	0.2116	−0.0070	<b>0.7124</b>
Spin-off NHE	0.0983	−0.0439	−0.0487	0.0343	<b>0.8480</b>
Eigenvalue	4.444	1.561	1.476	1.445	1.405
Explained variance	0.296	0.104	0.098	0.096	0.094

Note: Principal components technique with Kaiser Normalisation. Total variance explained: 0.689. Results in bold indicate in which factor the knowledge exchange activity has been included.